

IBM Flash Storage and Software Defined Storage

Flexible and scalable
enterprise storage solutions

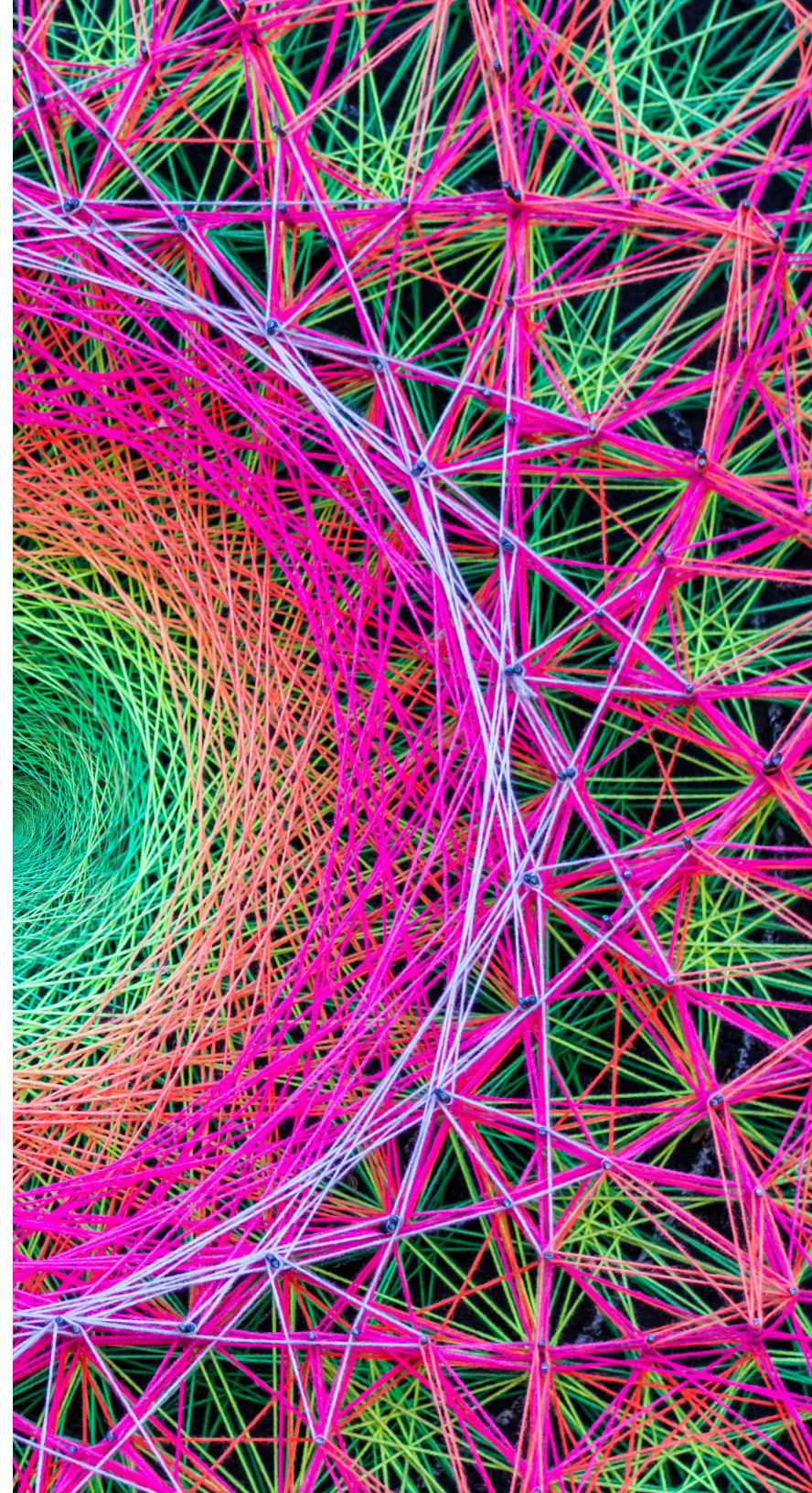
Executive summary

Struggles in today's IT organizations tend to stem from explosive data growth and dynamic data use. Innovative mobile applications, big data analytics, and shifts to cloud-hosted solutions to support business initiatives are pushing traditional storage approaches to their limits. Consequently, organizations attempt to respond to storage demands by increasing storage capacity, expanding to cloud on an ad-hoc basis, or even testing murky waters by attempting to manually manage their heterogeneous systems.

Scale, integration, and flexibility have consistently been challenges with traditional data storage. To address these issues, IBM® has continued to improve its Flash Storage hardware and Software Defined Storage (SDS) capabilities across mainframe and distributed platforms. This is made

possible through a suite of hardware storage offerings based on the expansion of FlashCore technology and adjustments in the SDS suite of products.

The SDS offering provides true centralized management across IBM storage offerings and a comprehensive list of other storage manufacturers. IBM Flash Storage on the other hand is geared to pair with other IBM and non-IBM storage to help drive performance. Together these offerings are well engineered for tackling the three big V's of data—velocity, variety, and volume. We'll explore the drivers facing many technical executives around complex storage needs, business cases on how to address these issues, technical architectures, and resulting business benefits.



Defining the problem

As more organizations move from an on-premise platform to a cloud or hybrid cloud model, there is a growing need for single pane storage management products with software-defined capabilities that offer low latency. For many, these are a necessity for mission critical applications.

Even with big data management, where organizations often use a combination of commodity storage and enterprise storage, the challenge of dealing with a software-defined storage solution that can scale while also providing deep management capabilities continues to be a major gap for CIOs and CTOs. This includes start-ups that are trying to tackle big data applications and need to have their offerings work across data centers and public cloud infrastructure.

The added challenge of providing consistent IT services by employing quality control measures, such as managing non-production and production configurations consistently, is further compounded by licensing costs and capacity considerations. IT executives often face major configuration mismatches within the infrastructure due to licensing constraints imposed by vendors that don't include development and test environments. This hinders research and

development, which is essential for a visionary IT executive to foster innovation and still adhere to a realistic budget.

As large IT organizations follow heavy project-driven procurements, the infrastructure footprint for storage arrays can often have a mix of multiple equipment manufacturers and technologies. This can lead to a major storage management challenge. The cost of training storage engineers and having a different set of management practices by appliance can lead to an increase in total cost of ownership—pushing IT organizations to seek single pane products, many of which simply provide report out features as opposed to a true provisioning, management, and monitoring console.

Executive leadership also faces ongoing IT staffing challenges to do more with less, often leading organizations to focus on improved automation of service delivery. In the realm of storage challenges, All Flash Arrays (AFAs) and SDS are viewed as the disruptors that can tackle these challenges effectively. These technologies matured rapidly—growing automation, information exchange, and digital disruptors—due to the increase in demand driven by data explosion. ➤

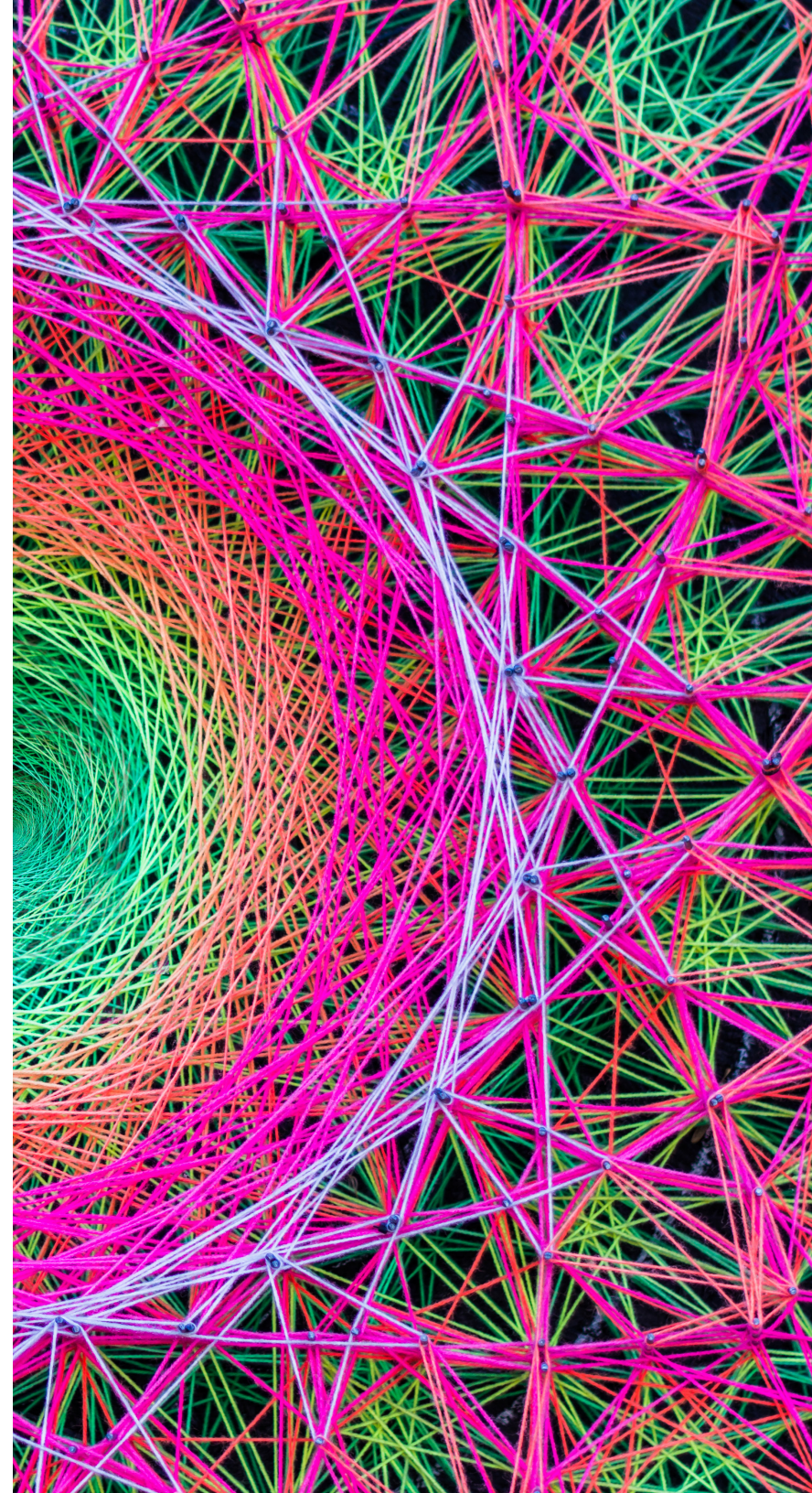


Figure 1: Why consider All Flash Arrays?

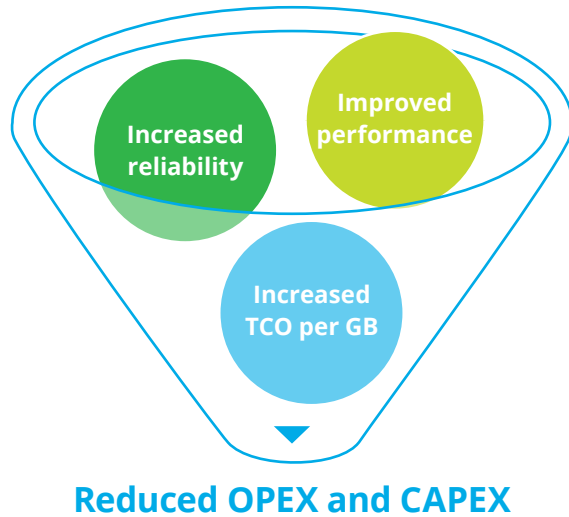
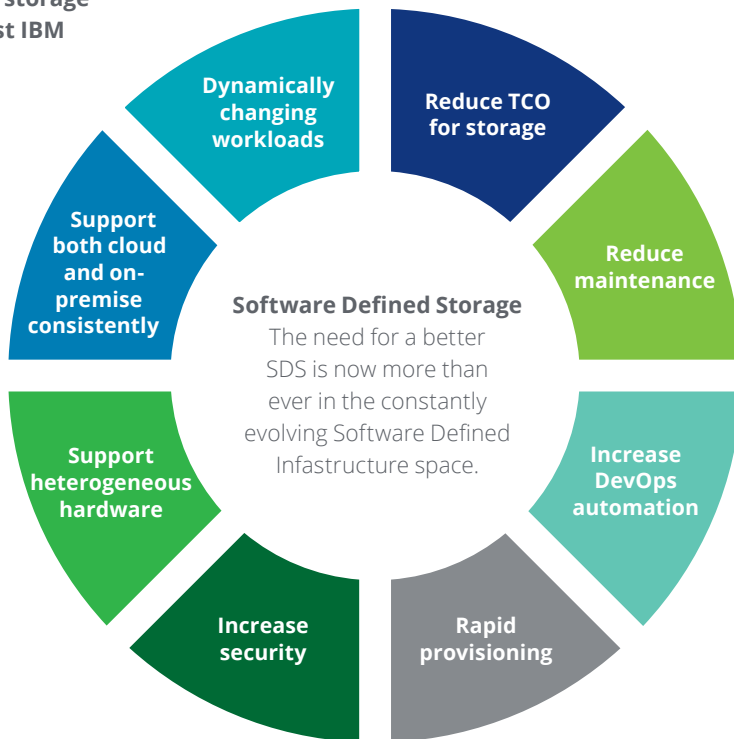


Figure 2: Typical use cases for Flash storage mapped against IBM Flash offerings



Drivers for All Flash arrays (AFAs)

AFAs offer a hardware solution for reducing capital expenditures. They facilitate this reduction by removing the need to add disks continuously to gain partial Input/output Operations per Second (IOPS).

AFAs have lower disk failures over traditional arrays, allowing for reduced operational expenditures. They also have more IOPS over traditional arrays, reducing the time required for data processing, migration, and de-duplication. For use cases where velocity is key—Internet of Things and big data—AFAs offer the low latency processing backbone needed to support reduced data processing time.

AFAs can be used for active data processing and/or storage based on the use case needs. For example, a lot of big data warehouses use about 20 percent of their data for active querying. Shifting only that portion to an AFA and keeping the rest on tiered storage could allow them to support the business at a fraction of the cost over the continuous addition of tiered IOPS to a large array.

Another advantage in virtual server environments is to move either entire sets of actively used virtual machines (VMs) or critical ones onto AFAs that require low latency VM cross-node migration without sacrificing performance. This is also why AFAs are popular for virtual desktop infrastructure use cases where oversubscription is high and reliance on the storage array is heavy while the

workload migrates from a busy to a resource available compute node. AFAs also promote a greener IT organization by reducing power usage, cooling costs, and space requirements along with increased tolerance for vibration and temperature changes.

Drivers for software defined storage (SDS)

As the IT organization becomes an innovation center instead of just a cost center, it's challenged with providing more on-demand capacity for constantly fluctuating workloads. This is driving a restructuring of the IT department around key themes such as being agile, being DevOps-enabled with high automation, and dynamic scaling for infrastructure to support demand-based tracking. These themes require a heavy traditional infrastructure capacity or a lean software-defined infrastructure that can allow for nimble capacity management and support massive scale up and scale out.

Compute and network have seen significant benefits from virtualization and software-defined technologies like containers. However, enabling SDS continues to be a difficult task for many IT organizations to architect for flexibility and performance in a constantly evolving workload landscape. Since large IT infrastructure procurements often happen as a result of project-based procurements, organizations can fall victim to vendor tie-in for hardware and vendor-specific SDS technologies.

Targeting Flash storage offerings by key workloads

- Application acceleration
- Virtual storage infrastructure
- Grid scale cloud storage
- Big data storage
- Business critical storage

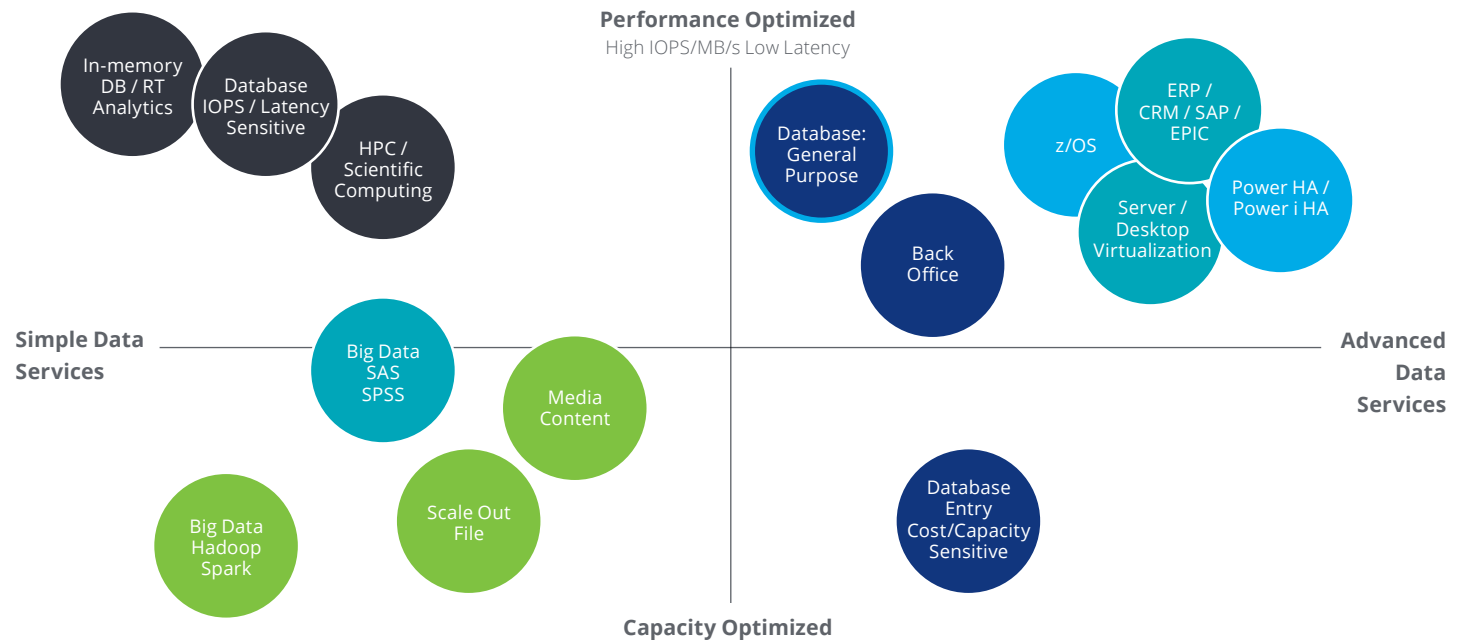


Figure 3: Typical use cases for Flash storage mapped against IBM Flash offerings²

There is a growing movement in IT for SDS technologies to align with open standards such as the OpenStack, however many manufacturers still end up introducing hard dependencies and constraints that can limit cross-platform scale out. For many organizations the need for SDS is no longer in question. Instead the focus has shifted to finding the applicable SDS that can keep up with the constantly changing technology landscape. This means IT organizations can invest in training staff with skills on a technology that their enterprise can continue to use for a long time.

Why consider IBM Flash offerings?

IBM uses microcontrollers as opposed to traditional microprocessor- and processor-based AFAs. This may provide an advantage

in terms of overcoming processor-based cache limitations and minimizing bus latencies within the storage. The reliability may be increased by the micron-based durable chipset at the core of IBM Flash technology.

IBM Flash offerings are classified by the type of complex workload use case, which map to a majority of IT organizations ranging from entry level to large enterprise scale.

Organizations looking to improve data migration and data mobility and achieve true data agility should look to All Flash solutions in order to gain that unique mix of high performance and financial savings across the full range of deployment and operational activities.

Why consider IBM SDS offerings?

IBM SDS has a range of products for end-to-end storage management capabilities that support more than 400 major hardware platforms from different vendors. Virtually limitless elastic data scaling combined with a simplified architecture can allow IT organizations to rapidly provision storage for initiatives—from prototyping, hyper-converged, and converged to full grid scale optimized infrastructures. Products such as IBM Spectrum Scale™ allow IT organizations to support mission critical workloads with no downtime while providing management ease and automation. The flexible per TB licensing for production includes a no-cost license for non-production use. This can be a savings accelerator for organizations

with active product development or heavy projectized environments where the non-production storage tends to be significantly larger, heterogeneous, and constantly fluctuating. Additionally, IBM SDS is a ‘follow you’ license as opposed to ‘follow the hardware vendor.’ This allows organizations to swap hardware based on their needs with the flexibility to shop across a pool of vendors without having to worry about re-training the storage team. IBM SDS provides greater storage infrastructure flexibility to share resources, maintains the required service levels, and allows organizations to better use data for greater business insights.

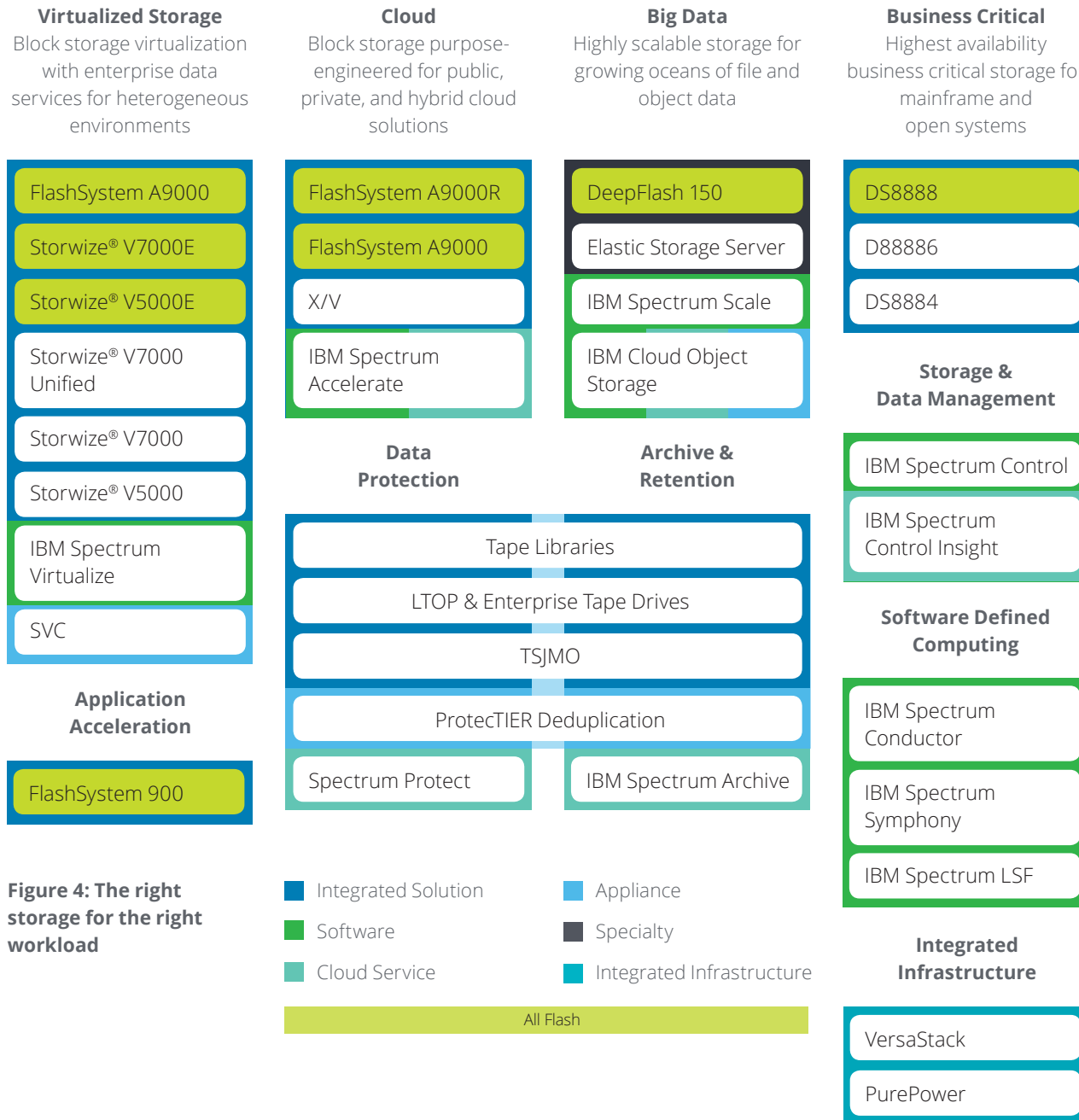


Figure 4: The right storage for the right workload

Why consider them together?

- A combination of performance with the need for management flexibility in a SDI can be delivered by combining these products together. This allows for the reuse of existing investments in tiered or lower speed arrays for more archival and lower priority workloads, while still having SDS provide a consistent, unified way to manage workload distribution by performance profile.
- IBM Spectrum-based SDS products and Flash lower administrative challenges and reduce the footprint for data center management in terms of physical space required, software tools to manage, and existing asset reuse. One of the biggest advantages of SDS is letting customers take their licenses without a tie to the hardware. Similarly, IBM Flash offers one of the fastest performance per GB and allows for distinguishing between fulfilling capacity needs vs. performance needs of storage that a traditional array cannot provide.
- IBM Flash and SDS technologies can be scaled to fit business need and not necessarily an “All In” package. This leaves organizations with the option to select hardware and software based on business need and add onto it later.

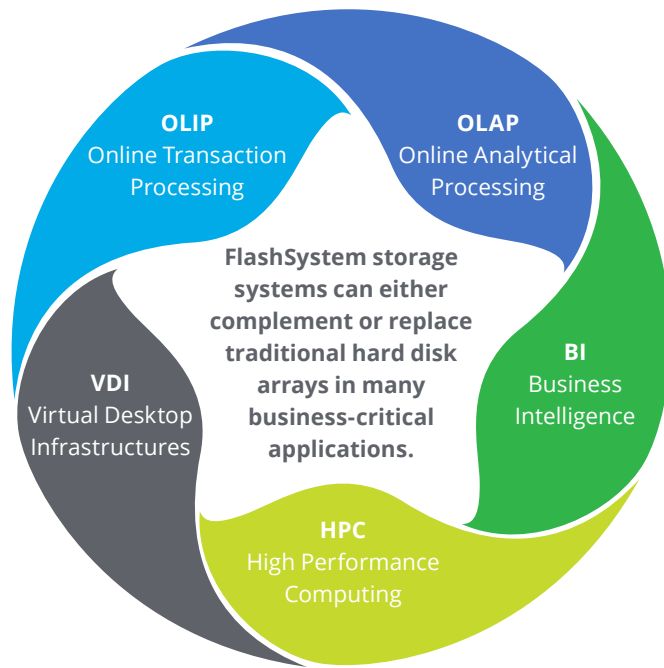


Figure 5: Right storage for the right solution

Figure 6: Benefits of FlashSystem storage solutions

A 1U form factor, which has a minimal footprint for optimum ROI

Two dual-port 8 GB Fiber Channel controllers or dual-port 40 GB QDR InfiniBand controllers

350 watt or less power draw

Hot-swap flash modules to enable uninterrupted operations

Up to a petabyte (PB) of FlashSystem storage can be placed in a single rack, on a single floor tile

Storage approaches

IBM Flash approach

With the most recent models of V9000 Flash storage, IBM continues to build upon its history and tradition of producing hardware to support different workloads and business needs. Combining IBM hardware and software can allow for an effective experience and performance and the ability to reuse existing storage or add more in the future. IBM has also worked with Micron on development of the actual flash chips, adding optimization and reliability.

Economics is a key factor in determining whether to opt for IBM FlashSystem™ (FlashSystem). Flash costs more than SSD and HDD per TB, but if the consideration is for performance and speed over cost, Flash might be the optimal choice. Choosing the right storage is crucial to the entire environment.

For businesses focused on big data and cloud environments, FlashSystem products are ideal to meet this need. These storage systems can either complement or replace traditional hard disk arrays in many business-critical applications.

For organizations focused on consolidation and a reduced technical footprint, FlashSystem products help consolidate hardware and software, increase deployment speed, and reduce work for IT staff.

For organizations with green initiatives focused on reducing costs through energy efficiencies, FlashSystem storage systems can offer:

- Energy-efficient flash components to drive lower operational costs
- One of industry's best IOPS per watt ratio to maximize energy savings
- Hexagonal ventilation holes, a part of IBM Calibrated Vectors Cooling™ technology (Hexagonal holes can be grouped more densely than round holes, providing more efficient airflow through the system)

FlashSystem storage is a more cost-effective solution where using multiple SSDs would have been the only other alternative. Also, the latency that is caused by a software data path and application processing can be greatly reduced by FlashSystem products that have a hardware-only data path and low latency. ➤

Product	Plane	Product Description	Benefit
IBM Spectrum Control™	Control	Automated control and optimization of storage and data infrastructure	Single management console for the Spectrum suite of products. Allows for monitoring and health check across storage devices.
Copy Services Manager	Control	Automated control and optimization of storage replication features	Plan and manage replication across storage devices
IBM Spectrum Protect™	Control	Optimized data protection for client data through backup and restore capabilities	Provides consistent Disaster Recovery (DR) replication and easy DR management
IBM Spectrum Protect Snapshot	Control	Integrated application-aware point-in-time copies	Provides hardware and application agnostic snapshots, including relational database systems
Spectrum Copy Data Management	Control	Automate creation and use of copy data snapshots, vaults, clones, and replicas on existing storage infrastructure	Allows for easy replication and management data
IBM Spectrum Virtualize™	Data	Core SAN Volume Controller function is virtualization that frees client data from IT boundaries	Provides for the virtualization across the underlying storage
IBM Spectrum Accelerate™	Data	Cloud enterprise storage that is deployed in minutes instead of months	Accelerates deployment of storage within the cloud
IBM Spectrum Scale™	Data	Storage scalability to yottabytes and across geographical boundaries	File system that is able to manage large amounts of data across different storage
IBM Spectrum Archive™	Data	Enables long-term storage of low activity data	Provides easy integration with tape archiving solutions

Storage data compression

Along with providing hardware appliances that improve performance and lower operational costs, greater compression extends the utility of physical storage. Compression is the most common form of data reduction technology for most storage systems due to the continued expansion of data collection and use. As data builds in collateral, it is important to store that data in a way that maximizes storage capacity. IBM Real-time Compression uses IBM's Random Access Compression Engine (RACE) technology to help achieve a valuable combination of high performance and compression efficiencies.

Why does that matter? The cost of licensing can be reduced as compression reduces the overall storage requirement. This translates into savings, especially when storage is reduced by 20 to 50 percent.

IBM software defined storage approach

The objective of IBM's Software Defined Storage (SDS) is providing a flexible and scalable storage solution. IBM's approach is based on an architecture that separates the storage/data control and the data access planes and places them on top of any server or storage system. Each of these planes is then supported by IBM's Spectrum software

suite, which provides the management and maintenance capabilities for the underlying hardware infrastructure. This configuration allows for a singular view of all virtual storage that has been provisioned, as well as the underlying servers and hardware.

The IBM Spectrum software suite is a comprehensive set of software components that are designed to support all aspects of SDS. This suite can be used as a whole or as individual pieces, allowing it to be tailored to the individual requirements of each implementation.

To support the control and data plane, SDS relies on a set of underlying storage hardware that could be flash, disk, or tape and from multiple vendors. This makes it a good candidate for greenfield implementations and integrating with existing storage infrastructure. This hardware agnostic approach allows reuse and incremental upgrade or expansion of existing hardware and a variety of solutions that are already in place.

Even while supporting multiple types of storage, creation/management/destruction can be handled in a consistent way from one location. This helps streamline the overall management and maintenance of

the storage. Additionally, SDS helps meet security needs by supporting various types of encryption, which can be managed internally or via IBM Security Key Lifecycle Manager (SKLM).

SDS architecture overview

The overall architecture of IBM's SDS provides for on-prem, cloud, or a hybrid mix of both implementations. The flexibility of this SDS approach (especially in combination with IBM's FlashSystem storage) allows organizations to mix and match storage for the combination that's right for them.

The Spectrum SDX platform allows for all of an organization's storage to be connected to and managed from a single console. This includes on-premise IBM storage, on-premise non-IBM storage, cloud service providers (Softlayer and other major providers).

The inclusion of IBM and non-IBM storage helps organizations reduce a challenge they often face when procuring new hardware—what to do with legacy hardware. With IBM's Spectrum platform, it can continue to be used by integrating it into the storage pool. For organizations with a cloud storage footprint (or those who anticipate gaining one), this storage can also be incorporated

into their pool. Having the ability to include these three distinct types of storage allows organizations to maximize storage types and options.

Despite the numerous combinations of storage possibilities, the allocation and management of it is still simple and straightforward with IBM's Spectrum SDX platform. The various types of storage are presented to end users in a heterogeneous manner, allowing it to be managed in the same manner as traditional virtualized storage.

There is a broad set of Flash hardware storage options available spanning virtualized storage, cloud, big data, and business. It provides a comprehensive opportunity to integrate hardware based on workload or business need and a software solution to manage and administer it all.



Case studies

Here are some examples of how different companies have leveraged IBM Flash or SDS products to help solve business challenges or achieve business objectives.

Case Study I: A marketing and solutions company in Japan

Business challenge

A marketing and solutions company for a leading electronics giant needed to boost performance, response times, and employee satisfaction by reducing daily wait times of mission-critical applications.

IT headquarters was responsible for maintenance and operation of several mission-critical applications used daily by approximately 4,000 of the 18,000 employees across its various offices. To address the issue of increasing wait times, a mechanism was derived to allow mission-critical systems to be used as data warehouses by the company's information systems. IT headquarters also prepared a data mart that divided up the collected data according to use, helping users rapidly define and execute queries and retrieve the information they require. Complex SQL queries were used to process this data, with increasing execution time.

Most of the data marts accumulated data for a year, as a result of which the data and transaction volumes exceeded estimates and response times during peak periods started to deteriorate sooner than expected. With an average of approximately 15,000 transactions daily, and an excess of 50,000 transactions at the peak period at the beginning of each month, the company targeted a tenfold increase in the speed of data processing.

Solution

The company selected IBM FlashSystem all-flash storage, designed for high performance. Average response time achieved during the peak period at the beginning of the month was just 60 seconds. The company created a software-defined storage infrastructure by deploying IBM Spectrum Control™ and IBM Spectrum Virtualize solutions to manage its new FlashSystem and existing IBM Storwize storage devices. With these tools in place, the company was able to implement IBM FlashSystem with minimal changes to existing configuration, a key advantage. By adding FlashSystem to an existing virtualized storage environment, they improved the value of existing investments and introduced additional cost reductions.

When implementing IBM FlashSystem, the company needed to migrate data used by the business on a daily basis, which meant that it needed to minimize downtime. As a result, the company chose to divide the 40 TB of data to be migrated into two parts, with preparatory migration steps carried out over a month, and the main stages over just two days.

Impact

- Reduced daily wait times by 554 hours across its workforce
- Reduced use of floor space
- Decreased power consumption
- Reduced processing time for several tasks from one minute to 10 or 20 seconds
- Improved overall efficiency of operations by 83 percent

Solution components

- IBM FlashSystem
- IBM Spectrum Control
- IBM Spectrum Virtualize™
- IBM Storwize®

Case Study II: A public transport company in Germany

Business challenge

A leading transportation company in Germany manages diverse operations, acting as the main public transport provider in one of Germany's greater urban regions, as well as an IT service provider for a number of medium-sized companies. Slow response times impacted the company's ability to coordinate logistics and deliver safe, efficient transport to passengers.

It was a considerable challenge to meet the increasing capacity demands placed on the company's storage systems. They added more and more disks to their systems just to meet the service level agreements and provide the throughput rates customers needed for their mission-critical SAP systems. Overcapacity and high costs were the consequence, damaging margins and harming competitiveness.

Solution

The company relies on a solid hardware backbone of IBM Power Systems™ servers, running IBM AIX, to deliver enhanced performance for its business-critical systems, including an extensive SAP ERP application landscape. To manage growing quantities of data and provide fast access to vital information, the company extended its existing storage environment—based on IBM System Storage SAN Volume Controller—with high-performance IBM FlashSystem technology.

The company gained greater business insight and the ability to perform advanced data analytics by moving critical SAP ERP applications to Flash. It was also able to easily move whole systems or databases from traditional storage to Flash storage at the push of a button. This capability has increased agility and improved user experience and reaction time to changing performance requirements.

Impact

- Realized full ROI within five years
- Reduced total cost of ownership by about 50 percent over the previous solution
- Reduced critical batch process times by 98 percent

Solution components

- SAP ERP
- IBM Power Systems
- IBM FlashSystem 810
- IBM SAN Volume Controller
- IBM InfoSphere

Case Study III: A US commercial bank

Business challenge

This bank needed an end-to-end virtual desktop infrastructure (VDI) solution that could support more than two thousand desktops at 175+ branches and handle rapid growth.

The existing SAN storage could not support its virtual desktop infrastructure without slowing down other critical applications and they needed a scalable solution to handle business growth.

Solution

The bank eliminated performance issues, improved VDI density, and achieved high availability with IBM FlashSystem and Atlantis software.

Using Flash consolidated applications onto a platform with the capacity and performance scalability capable of supporting multiple applications. It avoided scale out hassle with high density flash. The bank was also able to centralize and virtualize without creating new silos.

Impact

- 12x better user density
- Reduced critical batch process times by 98 percent
- Prevented boot storms
- Lowered the cost per desktop
- Realized better performance than real desktop
- Lowered VDI installation risk
- 12 seconds boot time on a VDI, for a faster-than-local desktop experience

Solution components

- SAP ERP
- Atlantis ILIO
- IBM FlashSystem 820
- IBM Storwize V3700
- VMware VDI

Case Study IV: A telecommunications company in Egypt

Business challenge

This telecommunications company provides a full range of voice and data services to more than 22 million subscribers in Egypt, which includes telecom services to large Egyptian enterprises. With increasing competition, the company faced challenges in delivering enhanced performance, availability, analytics, and security to its growing customer base.

The company's fraud management system depends on data received from network switches to detect fraud, like unauthorized data usage. However it often took as long as three days to capture and analyze fraud data.

Solution

To resolve delays in its fraud management system, the company decided to use IBM FlashSystem V840. With the new storage technology in place, the company improved the efficiency of its fraud management application, reducing the time spent on processing call records by a factor of 15 times and improving the speed of fraud detection by a factor of 37 times.

With IBM FlashSystem V840, the company enhanced analytics performance while reducing storage footprint and lowering energy costs. This sped up real-time analytics of its Fraud Management System and allowed it to capture and virtually analyze fraud data instantly instead of taking three days. This helped the company improve its operations by 300 percent.

Using All Flash Arrays resulted in performance enhancements, significant savings in footprint, key application optimization, business operation and service level improvement, and better decision-making.

Impact

- 300 percent overall performance enhancement for FMS
- 20x better results in analysis time
- <500 microseconds read and write IOs
- Reduced storage footprint and lower energy costs

Solution components

- IBM FlashSystem V840
- IBM Spectrum Virtualize (SVC)
- FMS – Fraud Management System
- IBM Flash Centers of Competency

Case Study V: A US telecommunications company

Business challenge

This prominent telecommunication company's call-center agents needed fast, reliable access to respond to customer issues. Existing storage infrastructure was unable to keep up.

Solution

This company deployed IBM FlashSystem to help improve performance and resolve customer queries faster, while slashing energy consumption, data center footprint, and overall operations cost. The IBM FlashSystem solution allowed the company to identify and address potential customer issues faster, helping to maintain and build subscriber numbers.

Impact

- 33x faster performance than tier 1 EMC VMAX storage
- 3.6x more iPhone activations per minute
- #1 Ranking in customer satisfaction among national carriers

Solution components

- Oracle RAC
- IBM AIX
- IBM FlashSystem 820
- IBM SAN Volume Controller
- Microsoft Lync

Case Study VI: Network Fleet for a leading US telecommunications company

Business challenge

To support its broadband wireless and wireline services, a leading US communications company operates a fleet of nearly 45,000 vehicles throughout the U.S. To help improve customer service and control operational costs, fleet managers installed GPS tracking on 30,000 of those vehicles. The online GPS tracking solution by the company required innovative answers for problems of latency, queries, and reporting and required understanding flash alternatives such as hybrid arrays and inline accelerators.

Solution

Two IBM FlashSystem arrays were deployed to support fleet telematics such as location, where they are going, what they are doing, and monitoring operational health of vehicles. The company saw exponential improvements in performance and reporting, coupled with major reductions in environmental costs.

Impact

- 6x faster performance for fleet queries
- 15x reduction in IOPS latency, from 15ms or greater to less than 1ms
- 80 percent reduction in power
- 50 percent reduction in space to facilitate TCO savings

Solution components

- Oracle RAC
- IBM FlashSystem



Conclusion

FlashCore technology provides a wide array of storage sizing options for specific workloads to support a wide variety of businesses. SDS similarly has been developed to integrate and unify hardware across hosted platforms and vendor storage products, while adding numerous benefits.

While IBM may have a strong position in Flash technology and SDS, it is important for organizations to consider the complexities that accompany these products and recognize that Flash and SDS are not just technology solutions. Selecting these products often requires a long term vision and commitment to creating a defined IT strategy and road map. Lifecycle analysis of the existing hardware, architecture design, and the business use case the hardware is supporting also needs to be understood and considered. This includes involving stakeholders from all parts of an organization.

While these products can be used a la carte, usage of the suite requires time and forethought to implement successfully. Additionally, before implementing IBM's Flash technology and/or SDS, a careful evaluation and impact assessment needs to be performed on current software licenses for tools and products supporting this hardware. This is a complex and challenging exercise that may require involvement from the software vendors to validate and confirm an organization's findings.

In order to gain many of the benefits and efficiencies discussed, an organization's IT staff must implement and manage the solutions properly. This also means having dedicated staff or contractors with specialized skills for maintaining Flash and SDS.

It is critical for IT executives to continually look at their current and future IT landscape and determine what product or technologies will be necessary to meet IT and business objectives.

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2. IBM System Whitepaper: To Achieve True Data Agility, Consider a Move to All Flash Arrays. Retrieved from <https://www-01.ibm.com/common/ssi/cgi-bin/>

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Glossary

Software-Defined Storage (SDS) –

Computer data storage software for policy-based provisioning and management of data storage independent of the underlying hardware.

Flash memory – Electronic non-volatile computer storage medium that can be electrically erased and reprogrammed. Information is stored in an array of memory cells made from floating-gate transistors.

Solid-state drive (SSD) – Device used to store and retrieve digital information using electronic circuits, without the use of moving mechanical parts.

Hard disk drive – A data storage device that uses magnetic storage to store and retrieve digital information using one or more rigid rotating disks coated with magnetic material. The disks are paired with magnetic heads, usually arranged on a moving actuator arm, which read and write data to the disk surfaces.

Calibrated vectored cooling (CVC) – An air-cooling technology developed by IBM for server systems with high component density. CVC optimizes the path of air flow through the equipment, increasing the efficiency with which heat is removed.

Inputs/outputs per second (IOPS) – The standard unit of measurement for the maximum number of reads and writes to non-contiguous storage locations. When evaluating a new storage system, especially an All-Flash Array, the number of IOPS that the storage system can sustain is often used to differentiate one storage system from another.

IBM Random Access Compression Engine (RACE) – IBM's data optimization technique that compresses data in between transmission and application servers and storage devices.

Storage Area Network (SAN) – A network which provides access to consolidated, block level data storage. SANs are primarily used to enhance storage devices, such as disk arrays, tape libraries, and optical jukeboxes, and are accessible to servers so that the devices appear to the operating system as locally attached devices. A SAN typically has its own network of storage devices that are generally not accessible through the local area network (LAN) by other devices.

IBM® Power Systems™ – IBM technology for z/OS, to manage encryption keys for storage.

IBM z/OS® – A 64-bit operating system for IBM mainframes, produced by IBM.

Virtual desktop infrastructure (VDI) – A virtualization technology that hosts a desktop operating system on a centralized server in a data center.



Authors

Hemang Dholakia

Senior Enterprise System Architect

Deloitte Consulting LLP
hdholakia@deloitte.com

Venu Bommenani

Senior Technology Project Manager

Deloitte Consulting LLP
vbommenani@deloitte.com

Pete Evans

Systems Architect | Application Modernization

Deloitte Consulting LLP
petevans@deloitte.com

Mike Zawacki

Manager

Deloitte Consulting LLP
mzawacki@deloitte.com

Neethu Jacob

Consultant

Deloitte Consulting LLP
njacob@deloitte.com

Contributors

Robert Miller

Lead Architect | IBM Alliance

Deloitte Consulting LLP
robmiller@deloitte.com



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